

Information Technology Laboratory

The Information Technology Laboratory (ITL) is the preeminent engineering information technology laboratory in DoD. ITL conceives, manages, conducts, and coordinates R&D in computer-aided and interdisciplinary engineering, computer science, high performance computing, information technology, and instrumentation systems for other Corps activities, Army, DoD, and other agencies.

ITL develops, manages, and maintains the WES information technology infrastructure that supports the WES R&D mission. Through a bal-

anced program of R&D and demonstration, ITL advances the knowledge and ability to use the latest information technologies to address a wide range of engineering and scientific challenges.

ITL manages and operates four national centers for DoD, the Tri-Services, and the Corps of Engineers:



A Cray T3E and Silicon Graphics Power Challenge Array systems are two of the four major systems in the DoD HPC Major Shared Resource Center

- The DoD High Performance Computing (HPC) Major Shared Resource Center provides advanced computational assets and expertise to more than 1,200 DoD researchers nationwide.
- The Tri-Service CADD/GIS Technology Center develops and promotes computer-aided design and drafting (CADD) and geographic information systems (GIS) technologies for military installations and civil works projects.
- The Corps of Engineers Automation Plan (CEAP) Central Processing Center provides 60 percent of the Corps' total Management Information System processing.
- The Corps of Engineers Software Technology Center investigates software engineering technologies and provides technical support for the Corps.

Systems of the DoD HPC Major Shared Resource Center (MSRC) and the CEAP Central Processing Center reside in the WES Joint Computing Facility in the ITL headquarters building, the Jamie L. Whitten Building. Construction began in FY 96 on two major facilities enhancements. A 3,000-square-meter addition, scheduled for completion in FY 98, will provide computer laboratories, offices, and training facilities for over 100 engineers and scientists. A separate uninterruptable power supply and generator facility, completed in FY 97, ensures an even higher level of reliability for users of the DoD HPC MSRC at WES.

As part of WES's implementation of the Government Performance and Results Act (GPRA), ITL conducted its second organization-wide Peer Review. A distinguished panel of engineering, scientific, and information resource management leaders conducted a two-day evaluation focused on the quality of ITL's research, products, facilities, and staff. ITL achieved an overall rating of 4.4 on a scale of 5.0 from this evaluation.

Tri-Service CADD/GIS Technology Center. The Tri-Service CADD/GIS Technology Center was chartered in FY 93 under an agreement

among the engineering commanders of Army, Navy, and Air Force. The Tri-Service Center fosters application of CADD and GIS technologies for life-cycle facilities management, master planning, and architect/engineer/construction (A/E/C) efforts for DoD installations and for Army civil works projects. In FY 97, several major projects were completed and implemented within the Tri-Services.

The Electronic Bid Solicitations project replaces existing printed contract bid documents with an automated, on-line electronic bid package. It allows bidders to receive contract bid sets in CD-ROM format or through the Internet. The CD-ROMs contain all data related to the project (i.e. drawings, technical specifications, and contractual documents) and include a copy of a royalty-free viewer for document access and viewing. No additional hardware or software installation is required of bidders. Field testing, training, and initial implementation at most Corps districts was completed in FY 97.

Through the combined efforts of the U.S. Army Topographic Engineering Center and the Tri-Service CADD/GIS Technology Center, a software utility was developed in FY 97 to promote the management of survey control data. FY 98 enhancements will allow for more versatile map based querying, National Geodetic Survey data sheet maintenance, Internet querying, and metadata development specific to survey engineering.

The CADD/GIS Technology Center expanded and updated its Tri-Service Spatial Data Standards in FY 97 to integrate additional DoD requirements into a single, comprehensive master planning and environmental model for DoD installations and civil works projects. The Tri-Service Spatial Data Standards were developed as a national standard for geospatial data.

The first version of the Spatial Data Standards defined standards for graphic elements and nongraphic attributes as well as domains describing the graphic elements. It also defined standards for graphic symbology and other GIS display and digital characteristics. The data model was designed to function with

applications predominant in DoD (i.e., AutoCAD, Arc/Info, MicroStation, and MGE). Release 1.7 of the Spatial Data Standards, distributed at the end of FY 97, provides significant improvements over previous versions with added data content and user requested changes.

The Tri-Service Center continued to expand and update the Tri-Service A/E/C CADD Standards to integrate existing industry and national standards into a format satisfying the needs of architectural and engineering designers. De facto industry standards, such as the level/layer assignment methodologies of the American Institute of Architects and the Uniform Drawing Standard from the Construction Specification Institute, were expanded or augmented in the A/E/C CADD Standards.

Version 1.7 of the A/E/C CADD Standards addresses presentation graphics, electronic file naming, and level/layer assignments in a format that minimizes any commercial CADD-system bias. Criteria address the design and construction aspects of storage facilities, housing, civil works, transportation infrastructure, and other critical facilities. The design disciplines addressed include architectural, mechanical, structural, electrical, civil/site, security, and interior design. Software applications or “work spaces” were completed to provide a transparent implementation of the standard. Distribution of the “work spaces” is scheduled for FY 98.



Standards for A/E/C CADD and Spatial Data developed by the Tri-Service CADD/GIS Technology Center were widely embraced by government and industry

Nongraphical attribute information was added in FY 97. Initial attribute information addressed the architectural and mechanical disciplines and is being coordinated through the National Institute of Building Sciences CADD Council.

CEAP Central Processing Center. ITL continued in FY 97 to manage and operate the CEAP Central Processing Center, the larger of two national Corps of Engineers centers. The Central Processing Center handles 60 percent of the Corps' Management Information System processing and serves primarily the eastern and central United States, Europe, and several overseas projects.

The Center operates five Control Data 962-32, one SUN 6000, and four SUN 2000E computer systems. Both of the Corps standard accounting systems (Corps of Engineers Management Information System and Corps of Engineers Financial Management System) were supported by the Center. The computer systems at the Central Processing Center were used by over 20,000 Corps team members through a distributed network (CEAPNet) connecting all Corps activities.

Corps of Engineers Software Technology Center. The Corps of Engineers Software Technology Center investigates new and emerging software engineering technologies and methodologies, evaluates them, and recommends those most suited for Corps implementation. The Software Technology Center also provides technical support to the Corps to implement these new technologies and methodologies.

Programs and Project Management Information System. Deployment of PROMIS, the new standard automated information system developed by ITL to support Programs and Project Management, began Corps-wide in FY 96 and was completed in FY 97. One of the most advanced automated information systems ever undertaken in DoD, PROMIS is a 32-bit Microsoft Windows, client-server application written in Ada. PROMIS interfaces with commercial scheduling software and provides for management of resources and report generation for civil and military projects.

With PROMIS, the user can identify projects, define subprojects, create project-specific Work Breakdown Structures, designate responsibilities for task execution, classify tasks, estimate resource requirements, derive milestone dates, distribute resources over time, define and monitor contingencies, and generate standard and customized reports. PROMIS allows viewing of actual financial data from standard financial systems and provides summary level information.

Automated Integrated Master Plan System. Enhancement of WES's Automated Integrated Master Plan System continued in FY 97. The System combines master planning, engineering design, and facility management capabilities using CADD/GIS technology with a database that is fully compliant with the Tri-Service A/E/C CADD and Spatial Data Standards. Data and information requirements are organized into four operational phases including site mapping, infrastructure integration, engineering analysis, and facility management. This system serves as a model for DoD installations establishing their own automated master planning systems.

Reliability and Risk Analysis of Structures for Major Rehabilitation. ITL continued efforts in the area of engineering reliability and risk assessment for major rehabilitation projects. This program provides reliability models for project features under consideration for major rehabilitation and provides procedures to consider the impact of various chemical, environmental, or physical processes in reliability analysis.

Reliability models have focused on hydraulic steel structures, including gates on navigation structures affected by fatigue, corrosion, and crack propagation; concrete deterioration and over-stressing in lock chamber walls, including the effects of freeze-thaw and abrasion; anchored and nonanchored gravity structures; sheet pile guidewalls; and turbine blades at hydropower facilities.

In FY 97, procedures were developed for assessing the time-dependent reliability of hydraulic steel structures, such as miter gates. Reliability analysis was added to the Computer-Aided Structural Engineering program "CPGA" to create a modular computer program to calculate the reliability of pile groups. Advanced reliability procedures were added to previously developed models.

WES continued to develop guidance for conducting required risk-based benefit-cost analyses. Computer procedures were developed to apply this guidance to reliability assessment and quantification of structural degradation rates, including alternative time-dependent formulations and hazard functions. WES, along with engineers from the Corps' Ohio River Division, continued to simplify these time-dependent formulations for the Ohio River Mainstem Navigation Study.

Civil Works Guidance Update Maintenance Program. ITL manages the Civil Works Guidance Update Maintenance Program (CWGUMP) for Corps' Headquarters. CWGUMP is reducing the number of civil works guidance engineering manuals and publications from over 415 to a number that can be efficiently maintained and updated. The five-year goal of 230 documents is being accomplished through consolidation, rescission, supersession, and elimination of guidance documents without sacrificing technical sufficiency. New guidance reflecting state-of-the-art technology, innovative design concepts, and unique analysis methods is being developed and included in the CWGUMP.

Communications. On behalf of WES, ITL has developed and manages one of the largest high-speed, high-bandwidth communications networks in the nation. Two fiber optic backbones comprise the networks. By the end of FY 97, the first of these communications backbones consisted of over 13 miles of buried fiber optic cabling capable of FDDI (100-Mb/sec) speeds. It connected 72 local area networks, 48 R&D facilities, and all WES researchers to R&D computing resources. The second backbone consists of 8 miles of single-mode fiber optic cabling,



The Network Monitoring Facility enables WES to proactively manage its fiber optic backbones, local area networks, and associated communications assets

which was used to implement a WES ATM Network Testbed operating at 622 Mb/sec and scalable up to 2.5 Gb/sec.

The WES communications network also provides access to several national networks such as DREN (Defense Research Engineering Network), Internet, NSFNet, MILNet, and the nationwide DoD ACTS ATM Internetwork (AAI).

Electronic Information Exchange. ITL manages an Electronic Information Exchange (EIE) initiative that is based on the existing technological infrastructure at WES. EIE exploits the capabilities of electronic messaging to streamline information exchange at WES with a focus on management and administrative tasks.

The initial emphasis of EIE was to establish electronic messaging connectivity and a central electronic mail directory. The flagship electronic mail system has been interconnected with electronic mail systems internal and external to WES via SMTP and X.400. Remote access is provided via the World Wide Web or a dial-up connection. This infrastructure is the foundation for development of messaging enabled applications, such as electronic forms routing and workflow management.

Information Technology (IT) Planning. The integration of high performance computing, high bandwidth communications, high performance graphics and work automation provides the means to accomplish the previously impossible in terms of understanding solutions to

scientific and engineering problems. IT planning played a key role in achieving a corporate information infrastructure that efficiently supports the WES mission.

In FY 97, ITL defined information goals to improve mission and program performance, planned how to accomplish objectives, and provided guidance on priorities for WES. This effort included providing information on requirements and resources for all subdisciplines of the Information Mission Area. The Planning and Data Management Group also served as the contract monitor to provide contract IT services to all laboratories and support elements at WES in the areas of business applications, scientific and engineering applications, and facilities management.

Planned from a corporate perspective, the current information infrastructure at WES includes personal computers, minicomputers (work stations and file servers), graphics and CADD systems, data acquisition and control systems to support physical models, five CDC and five Sun mainframes, and five high performance computers. Each laboratory at WES has multiple local area networks, offering access to a powerful set of information resources (CD-ROM servers, printers, plotters, etc.) via the WES high-speed fiber optic backbone networks.

Records Management Services. In FY 97, to progress from stand alone to network use of electronic forms and software, 500 licenses for Symantec FormFlow were purchased and placed on the network. WES personnel were provided guidance on procedures to access the upgraded software and electronic forms.

Network access of the software and forms is eliminating duplicative ordering of software and manual distribution of the electronic forms. It also ensures that new and revised electronic forms are in a central location for easy access and that statistical information used in various reports and for the purpose of upgrading the software is easily ascertained. More than 1,500 electronic forms are on the network and available to WES personnel.

The Mail Center Functions were contracted out to the Mississippi Industries for the Developmentally Disabled in 1995. In FY 97, the Mail Center processed 1,619,631 (incoming and outgoing) pieces of mail.

The Records Management team managed 87 self-service copiers at WES and provided training to new personnel on correspondence, record-keeping procedures and mail preparation. The Records Holding Area, via the Centers Information Processing System, upgraded its capabilities to include electronic approval of SF 135. This resulted in a faster turnaround approval period for retiring records to the Federal Records Center.

Research Library Services. ITL operates WES's scientific and technical Research Library to serve the specialized needs of WES and the Corps. ITL personnel also provide administrative coordination for five DoD Information Analysis Centers at WES.

The Research Library's collection exceeds 540,000 items and covers all areas of civil engineering and physical and biological sciences. In addition to its own extensive collection, the WES Library has access to vast amounts of information through computerized information retrieval systems. The Library is capable of supporting research at the doctoral level.

In FY 97, the Library processed over 23,150 requests for information, compiled 1,100 bibliographies, conducted 1,600 literature searches, and filled 4,000 requests from other libraries to borrow WES materials. The Library received and maintained over 1,700 different periodical subscriptions for the year and processed 5,410 article reprint, book, and technical report orders. More than 5,530 items were processed and cataloged into the Library's shared on-line data bases. The Library also provided acquisition and cataloging services for three other Corps agencies.

The Research Library continues to enhance its automated integrated library system. The WES On-Line Library Facility (WOLF) and a CD-ROM network are accessible to all WES

personnel from their offices. The Library also provides a constantly updated Internet website, adding several new products this year, including Construction Criteria Base, Encyclopedia Britannica, and three full-text electronic journals. Access was also provided through the homepage to the WES List of Publications, the Library's online catalog, the electronic table of contents, and Engineering Village.

Visual Information and Publishing Services. The Visual Production Center (VPC) provides support in the Information Mission Areas of printing and publishing and visual information to WES researchers. New computer software, improved computer resources, and personnel training enabled VPC to meet customer needs with new techniques, including customer support in areas such as electronic presentations and Internet publishing.

Professionally prepared exhibits created by VPC were widely used and exhibited at major technical conferences and meetings throughout the United States. One major success was the exhibit support provided to the Tri-Service CADD/GIS/ Facility Management Symposium '97 in St. Louis, Mo.

A complete video production facility serves WES. High-quality videos have surged in popularity among researchers and program managers to explain research to a wide range of audiences. VPC continued to create computer anima-

tions with many new enhanced capabilities. VPC creates complex presentation graphics for customers, but also operates an imaging center to output viewgraphs, slides, and color hard copies from files created by WES researchers.

VPC has improved capabilities in the area of color imaging and output, which allow researchers to create their own color files and store them on diskette for VPC printing or to send their files electronically to VPC. A new FTP site enables electronic transfer of large files to VPC for use in a variety of products.

VPC prepared, edited and published more than 420 reports, pamphlets, bulletins, brochures, and other technology transfer products during the year. Writer-editors directly supported a number of major Corps research programs, wrote published articles, made presentations, and facilitated many technology transfer efforts. VPC writer-editors are assisting WES researchers by serving as pagemasters for home pages for the Internet. VPC visual information specialists are using Internet-specific software to design web sites and to place documents on the World Wide Web.

Technology Resource Center. The Technology Resource Center's (TRC) Help Desk is actually two separate Help Desks. One is a central point of contact for WES computer users, and another is for the DoD HPC MSRC computer users needing support.

In FY 97, the TRC Help Desk team responded to more than 12,164 calls for assistance from ITL's computer users and the HPC MSRC Help Desk responded to more than 6,820 calls. In addition to WES users there were users from other Corps offices, the Army, the Navy, and the Air Force.

Instrumentation Systems Development Division. ITL's Instrumentation Systems Development Division (ISDD) is the Corps premier organization in the mission areas of sensors, sensor-interface software, electronics, and feedback-control systems.



Technology transfer products include exhibits, displays, and other mediums

ISDD's efforts fall into two general categories: R&D efforts whose end products are sensors or measuring or controlling systems, and activities that support R&D efforts of other WES, Corps or federal organizations. Because of its unique and broad mission, ISDD is ubiquitous throughout WES, with its activities significantly affecting all five WES laboratories.

ISDD instrumentation engineers developed unique data acquisition systems and designed customized reporting and display software to enhance the efficiency of Corps dredging operations. These systems monitor dredge material production and vessel parameters on both Corps and contractor operated vessels. ISDD engineers trained personnel from the Corps' New Orleans and San Francisco Districts in operation of the new systems.

ISDD and the Computer Aided Engineering Division conducted Prototype Barge Impact Experiments at the Old Allegheny Lock 2, Pittsburgh, Penn., as part of the Innovation for Navigation Projects R&D Program. For this project, a tow consisting of four standard fully-ballasted barges was driven into the lock wall. Thirty-six impact experiments were performed at attack angles from 5 to 28 degrees and velocities from 0.2 to 1 meters per second. Twenty-two measurements of acceleration, strain, force, and pressure were made on the barge tow, while an additional six acceleration measurements were made on the lock wall. In all, over 1,000 channels of data were recorded during the project. This feasibility study will support a more substantial experiment scheduled for 1998.

Personnel of the WES Coastal and Hydraulics Laboratory (CHL) were supported by ISDD engineers and technicians at the Lake Washington Ship Canal to determine the cause of fish kills in the culvert system. Measurement of pressure, flow, and vibration were made in the culvert system under various operational conditions. These data were used to make recommendations to revise operational procedures for the site.

CHL personnel were also supported by ISDD professionals in the Rapidly Installed Breakwater (RIB) System research model experiments. ISDD designed and operated instrumentation systems that validated the RIB System performance. This included incorporating a new Video Motion Data Acquisition and Analysis System into the experiments.

ISDD supported the research activities of the Structures Laboratory through the design, development, and evaluation of measurement systems to measure the mechanical properties of concrete. Four unique measurement systems were designed and tested to evaluate their performance as a means of determining concrete workability (fluid properties of fresh concrete). The most successful system was developed into a portable prototype system for field evaluation.

Structures Laboratory personnel were also aided in the development of an ultrasonic scanning system for the nondestructive testing of concrete bridge decks. This system will help identify the nation's damaged bridges, which are estimated to number more than a quarter of a million. Field experiments with this new system were carried out on bridges in Mississippi, Nebraska, and Kansas. A patent is pending on the new device.

ISDD personnel received several patents in 1997. U.S. Patent 5,644,314 was for a hand-held or vehicle-mounted, processor-based system for detecting and identifying an object through high-resolution radar. The invention includes a ultra-high speed A/D data conversion system. U.S. Patent 5,675,555 was for an artificial fish surrogate that emulates the sensory organs of particular fish species. The surrogate allows measurements to be made of the environment seen by fish as they come close to potentially hazardous turbulent environments, such as near intake towers. Each fish surrogate has several piezoelectric and triaxial accelerometer sensors, and an intelligent optical fiber network data acquisition system.

ISDD maintains and upgrades the measurement systems for the Corps of Engineers Strong-Motion Instrumentation Program (SMIP). SMIP is administered by the WES Geotechnical Laboratory and is a nationwide structure monitoring network of analog and digital earthquake recorders. It consists of 436 accelerographs, on 131 structures, located in 33 states and Puerto Rico. ISDD personnel provide electronic support for about half of this instrumentation. Personnel installed new digital systems at several of the sites and monitored and maintained the existing systems.

ISDD provides significant design, development, and implementation support to the Site Characterization and Analysis Penetrometer System (SCAPS) Program, which is managed by the WES Environmental Laboratory. ISDD staff designed interface software and continued the design and development of special sensor probes and probe hardware to detect a wide

range of subsurface contaminants. Patent 5,635,710 was awarded to ISDD and Environmental Laboratory personnel and a private contractor. The patent covers the "Subsurface Penetrometer Radiation Sensor Probe System," which measures radiation in subsurface soil/groundwater formations using a spectral gamma detector protected in a hardened sacrificial steel housing. Two other patents are pending on other SCAPS research products.

WES Geotechnical Laboratory vehicle mobility studies were supported through operation and maintenance of electro-mechanical systems and the design and integration of data acquisition systems that service the mobility measurements. In one of these efforts, ISDD designed and fabricated a portable, electronic, hand-held cone penetrometer to measure soil mechanical properties.

The U.S. Army Centrifuge is the world's largest centrifuge. It was brought "on-line" at WES through the efforts of many groups, including ISDD staff. They helped design and fabricate many of the controlling systems, were responsible for diagnostic measurements made during acceptance-testing, and support many of the Centrifuge experiments.

One series of Centrifuge experiments was conducted in cooperation with the WES Structures Laboratory. It involved replicating at small-scale the results from a large explosive field cratering experiment. The field experiment employed a 454-kilogram nitromethane explosive charge. Because of physical scaling, the Centrifuge experiments required only 5-gram charges to generate 1/44.9-scaled craters of the same event. ISDD personnel developed and implemented the timing and firing systems necessary to detonate explosive charges on the Centrifuge arm. ISDD also provided signal conditioning and high-speed digital recording (one million samples/second) for the miniature ground motion sensors used on the experiments. Centrifuge experiments will replace some explosive field experiments in the future and will do so with significant savings in time and money.



SCAPS probe about to enter the ground



Miniature explosive charge being placed in Centrifuge cratering experiments, the ground shock sensors used to make measurements, and the resulting crater

ISDD provided measurement support for many other Structures Laboratory explosive effects and structural response studies in FY 97. One such study was the “Joint U.S./ Israel Full-Scale, Five-Story Structure Explosion Research Program” to address the survivability of protective structures. Ten explosive experiments were conducted on the full-scale, five-story building in Israel. On each experiment, ISDD made approximately 160 measure-

ments of ground shock, blast pressure, and structural response, for the three-week experiment series (approximately 1,600 total measurements).

Structures Laboratory experiments at Fort Polk, La., to investigate the airblast and cratering produced by untamped and water-tamped cylindrical charges over wet sand also required ISDD support. ISDD was responsible for blast instrumentation, which included the installation and acquisition of approximately 220 blast measurements on four experiments.